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# ALDSC All Hands

Irene Qualters

February 24, 2021

# Agenda

- **FY2020 Year in Review**
- Recent Highlights
- Pipeline and Diversity
- COVID Update
- FY2021
- Looking ahead
- Q&A



# LANL FY2020 Performance Summary

Goal	Rating	Percent
Mission Execution: Nuclear Weapons	Very Good	90%
Mission Execution: Global Nuclear Security	Excellent	95%
DOE & Strategic Partnership Projects Mission Objectives	Excellent	91%
Science Technology & Engineering	Excellent	95%
Mission Enablement	Very Good	80%
Mission Leadership	Excellent	91%
Total Overall	Very Good	88%

LLNL		
Nuclear Weapons	Very Good	90%
Global Nuclear Security	Excellent	95%
Strategic Partnership	Excellent	95%
Science Technology & Engineering	Excellent	95%
Mission Enablement	Very Good	90%
Mission Leadership	Excellent	91%
Overall	Excellent	91%

Sandia		
Nuclear Weapons	Very Good	87%
Global Nuclear Security	Excellent	95%
Strategic Partnership	Excellent	99%
Science Technology & Engineering	Excellent	100%
Mission Enablement	Very Good	89%
Mission Leadership	Very Good	85%
Overall	Very Good	88%



# Laboratory Agenda ensures simultaneous excellence

## Excellence in Nuclear Security

Design, produce, and certify current and future nuclear weapons, and reduce global nuclear threats

Champion  
**Bob  
Webster**



## Excellence in Mission-Focused ST&E

Deliver scientific discovery and technical breakthroughs that support DOE and NNSA missions

Champion  
**John  
Sarraf**



## Excellence in Mission Operations

Execute sustained operations that are reliable and responsive to mission needs

Champion  
**Kelly  
Beierschmitt**



## Excellence in Community Relations

Sustain and enhance LANL's partnership with the community across the Northern New Mexico region

Champion  
**Frances  
Chadwick**



# FY20 Lab Agenda – key deliverables for ALDSC

## 2.3 Advance the frontiers of computing to exascale and beyond

- Participate in national-level strategy and planning efforts for ECP and beyond; provide multi-institution leadership within the ECP (Lead: Irene Qualters)
- Shape ASCR post-ECP planning and ASC future platform strategies (Leads: Michael Bernardin, Irene Qualters)
- Explore, build, and lead novel computing initiatives, including industrial/academic/Laboratory partnership strategies in support of our mission (Leads: Beth Kaspar, Gary Grider)
- Establish LANL as a national leader in AI by accelerating development of AI-enabled capabilities for science and security (Lead: Aric Hagberg)
- Successfully procure, deploy, and operate the Crossroads Advanced Technology System and infrastructure to advance mission goals (Leads: James Lujan, Gary Grider)



Responsibility  
**IRENE QUALTERS**

- In addition to meeting program milestones in ASC, ASCR, and SPP, respond to emerging challenges and opportunities (Leads: Jason Pruet, Aric Hagberg)
- Assess and adjust institutional computing to meet a more diverse and innovative portfolio of emerging computing models and platforms at LANL (Leads: Michael Bernardin, Irene Qualters)

## 2.4 Assert leadership in the national quantum initiative

- Define and enhance Laboratory capabilities and areas of emphasis at the frontiers of quantum information sciences; support Weapons Program and national security mission needs (Leads: Michael Hundley, Michael Di Rosa)
- Develop and implement strategies for the Laboratory's quantum information sciences engagement with industry (Lead: Candace Culhane)
- Lead and define the Laboratory's engagement in the national quantum information sciences strategy (Lead: Irene Qualters)



Responsibility  
**TONI TAYLOR**

- Expand the number of researchers and students with training in quantum information science and technology to develop a workforce pipeline (Leads: Filip Ronning, Stephan Eidenbenz)
- Form alliances and partnerships to participate with the National Quantum Information Sciences Research Centers (Lead: Toni Taylor)
- Establish (with SNL) the CINT as the premier quantum information sciences leader for Nanoscale Science Research Centers (Lead: CINT Co-Director)

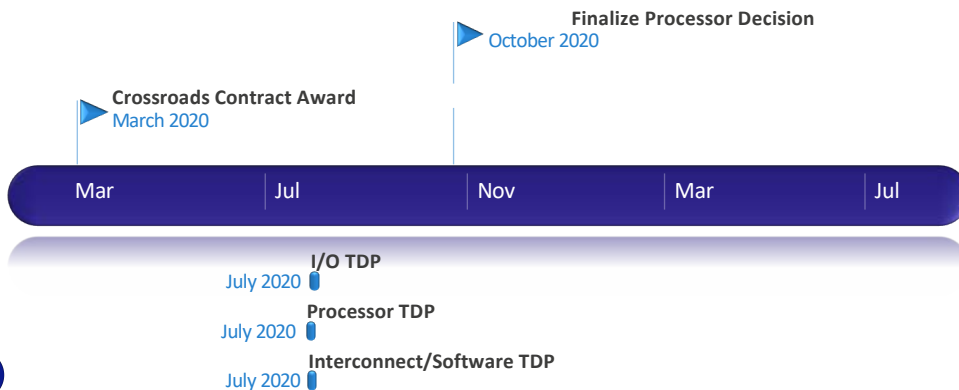


# Lab Agenda 2.3 : Crossroads in FY20



## Crossroads Goals (unchanged)

- Support 1–4 workflows simultaneously at 0.5PiB – 2PB of memory/workflow
- Enable more frequent longer-running higher fidelity 3D weapons performance simulations
- Provide a significant stockpile simulation capability for large-scale multi-physics applications in 2022
- Explore and exploit alternate technologies



Exascale Class Computer Cooling Equipment (ECCCE) Project completes early and under budget



Left to right: John Sarrao, Thom Mason, Gabriela Lopez-Escobedo, Lisa E. Gordon-Hagerty, John Gallegos, Kathy Segala, Michael Weis and Gary Grider cut the ribbon in front of the new cooling towers at the Nicholas C. Metropolis Center for Modeling and Simulation on July 16.





# Lab Agenda 2.3 : Shape future computing strategies

- ASC/ATDM Level 1 Milestone  
Achieved December 2020
  - Culmination of 6 years/4 projects/3 NNSA labs
  - Forward-looking software strategy based in reusable components, performance portability
  - High risk- high reward approach is setting the foundation for tomorrow
  - ECP/LDRD leverage

**We believe these demonstrations meet the metrics we identified at the mid-cycle review**

Mission Impact		Developer Productivity	
Turn-around times for demonstration problem on 25% Sierra and 50% Trinity along with same for EAP codes on 50% Trinity	✓	Ease of improving, modifying or extending code (Physics and CS infrastructure). Code reuse between codes measured and demonstrated	✓
Demonstration of ease of geometry setup, workflow, etc.	✓	Examples of algorithmic diversity	✓
In situ visualization and analysis enabled in FleCSI	✓	Software environment metrics (Repository statistics, Continuous integration statistics)	✓
Integration of necessary physics	✓	Documentation and training materials enumerated	✓
Demonstration of mechanism for model-form uncertainty	✓		
Portability		Code Performance	
Symphony demonstrated on Sierra, Trinity & Astra. Performance and memory usage documented	✓	Performance (Time to solution, cycle times, efficiency)	✓
Symphony demonstrated with MFJ & Legion. Performance and memory usage documented	✓	Weak scaling (Sierra vs Trinity vs Astra; MFJ vs Legion)	✓
Code differences for different systems and runtimes will be documented (physics and CS)	✓	Strong scaling (Sierra vs Trinity vs Astra; MFJ vs Legion)	✓
		Abstraction overhead (e.g. FleCSI, Legion, Kokkos)	✓



**Look for the checkmark**

*Slides closing the milestone are earmarked with a checkmark*

Checkmark @ AppDev: [CC BY-SA 4.0](#)



# Lab Agenda 2.3 : ECP Achievements

- IPR Review February 2021 Findings
  - Out brief from Review Committee:  
*Progress during the last year has been extraordinary – greater even than our most optimistic expectations.*
  - KPPs across Applications (AD), Software (ST), Hardware Integration (HI) elements are on track
  - Looking to future: Sustainability of software looms large



## Lab Agenda 2.3 : National leader in AI

### LANL Unique Technical Foci

- Current LDRD portfolio ~\$14M and mix of DR, ER, ECR, DI
- Response to DOE SC calls; BES SUF (Werner/CINT), FES/ASCR SciDAC (Tang, Lawrence, Perez), ASCR MLx2 (Hijazi, Livescu, Urban), ASCR Fair DATA (6) ECR (Hijazi)
- Trustworthy AI Director's Initiative (Moore, FY20)

### Mission R&D

- DOD projects started, and growing (Moore, Fairchild/Zeimann, Migliori), FY20=\$7M
- NNSA NA-22 portfolio: ADAPD, Neuromorphic computing
- DOE FE: multiple projects, growing portfolio
- ASC AML program soliciting/funding proposals (May 2020) FY20= \$5M, FY21 started new projects
- COVID response



# Lab Agenda 2.4 National Quantum Initiative

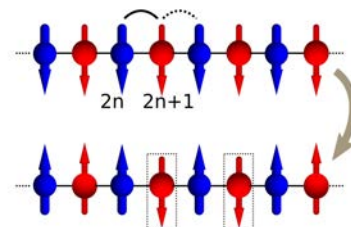
Research Leadership through Office of Science, ASC/ATDM, LDRD portfolio



Los Alamos leads key thrust in \$115M  
Quantum Science Center collaboration

“Nonadiabatic Phase Transition with Broken Chiral Symmetry,” Bin Yan, Vladimir Y. Chernyak (Wayne State University), Wojciech H. Zurek, and Nikolai A. Sinitsyn, *Phys. Rev. Lett.* 126, 070602 (2021), Feb. 19, 2021.

<https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.126.070602>



Community Engagement through pipeline, partnerships, and industry collaboration



Mission: Enable and grow a  
robust U.S. quantum industry



# Agenda

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- **Recent Highlights**
- Pipeline and Diversity
- COVID Update
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# Highlights - ALDSC



**“Legion” and  
“Amanzi-ATS” win  
R&D 100 Awards**



**Sumantra Sarkar  
(T-CNLS) awarded the  
2021 Irwin Oppenheim  
award from the  
American Physical  
Society**



**Key performance  
measure met for LDCC  
cooling upgrade**



**Tanmoy Bhattacharya,  
Thomas Leitner and  
Ralph Menikoff  
honored as three of  
seven 2020 Laboratory  
Fellows**



# Highlights



**Darren Comeau wins  
E3SM Outstanding  
Achievement Award**



**Bette Korber awarded  
Los Alamos Medal for  
her work in vaccine  
design.**



**Christine Anderson-  
Cook awarded the  
2021 George Box  
Medal**



**Luis Chacon, Ralph Menikoff,  
and Nikolai Sinitsyn named  
2020 APS Fellows**



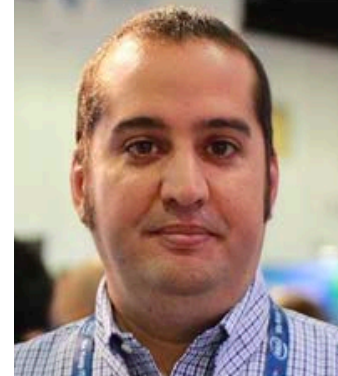
# Highlights



**Tariq Aslam awarded  
the Frank Harlow  
Postdoctoral  
Distinguished Mentor  
Award in Fluid  
Dynamics**



**T-4/CNLS postdoc Bin  
Yan wins Individual  
Postdoc Distinguished  
Performance Award**



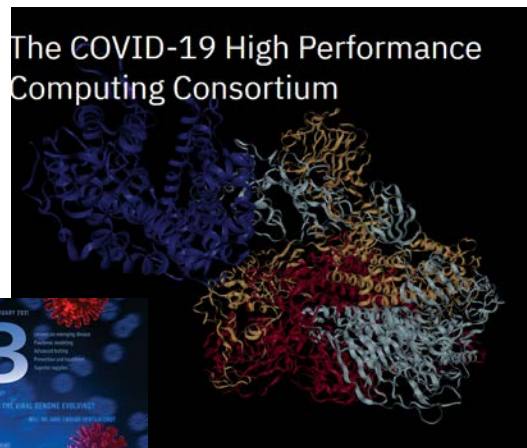
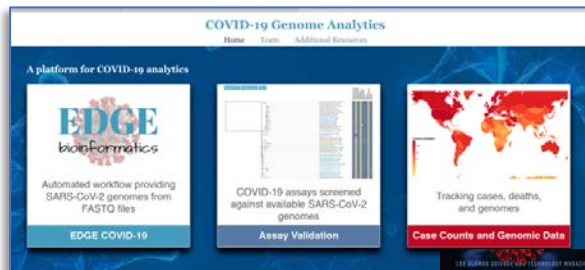
**Danny Perez will  
receive a Postdoctoral  
Distinguished Mentor  
Award**



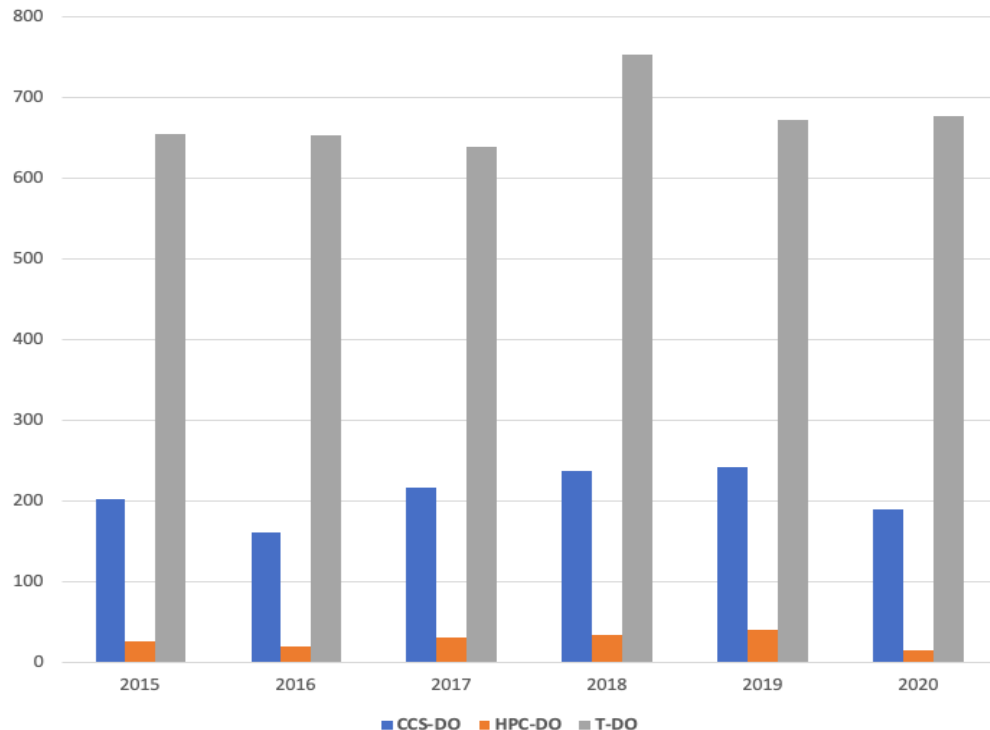


# Covid-19: Answering the Call

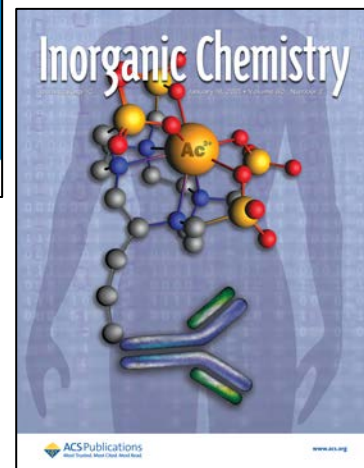
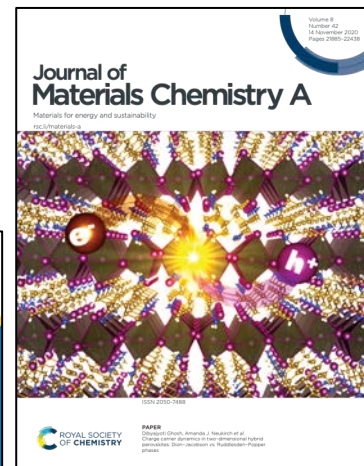
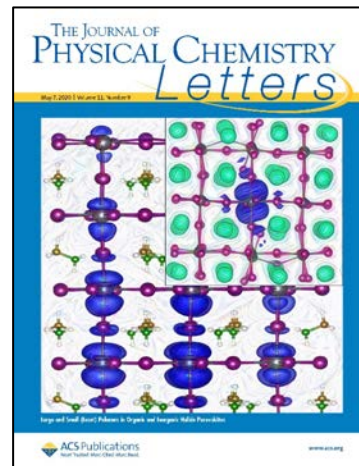
*From maintaining onsite HPC operations for mission essential activities,  
to assisting New Mexico with epidemiological forecasts,  
to advancing vaccine research,....*



# ALDSC 2020 Publication counts largely sustained through pandemic



Includes LA-URs and LA-CPs



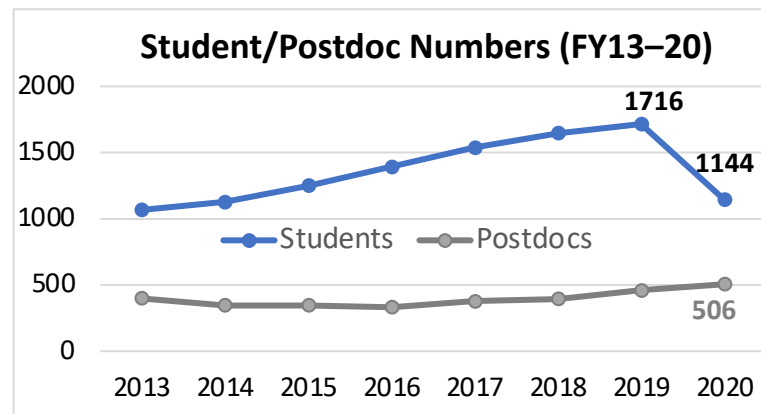
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# Pipeline and Diversity

- Hybrid student program planned for 2021
- Student programs and pipeline initiatives help boost diversity in student pipeline
- Increase FY2021 student population
- Continue to focus on all aspects of diversity



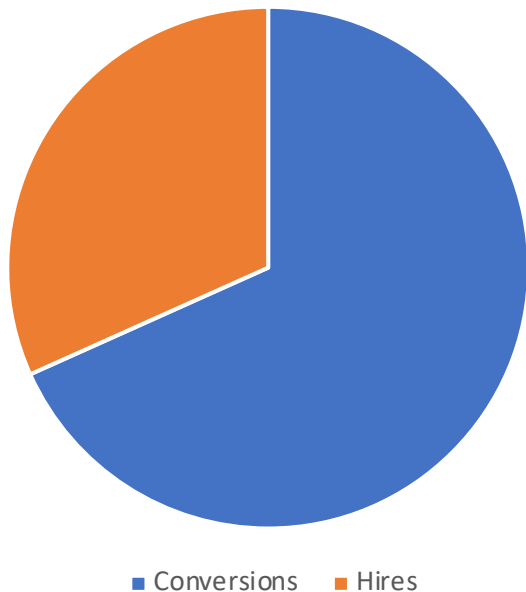
Postdoc Diversity*	LANL	DOE Nat'l Labs
Women	24.9%	25.5%
Under-represented minorities (URM)	6.8%	6.9%
Other people of color (OPC)	36.8%	43.8%

\*2020 (URM: Hispanic, Black, Native American; OPC: Asian)

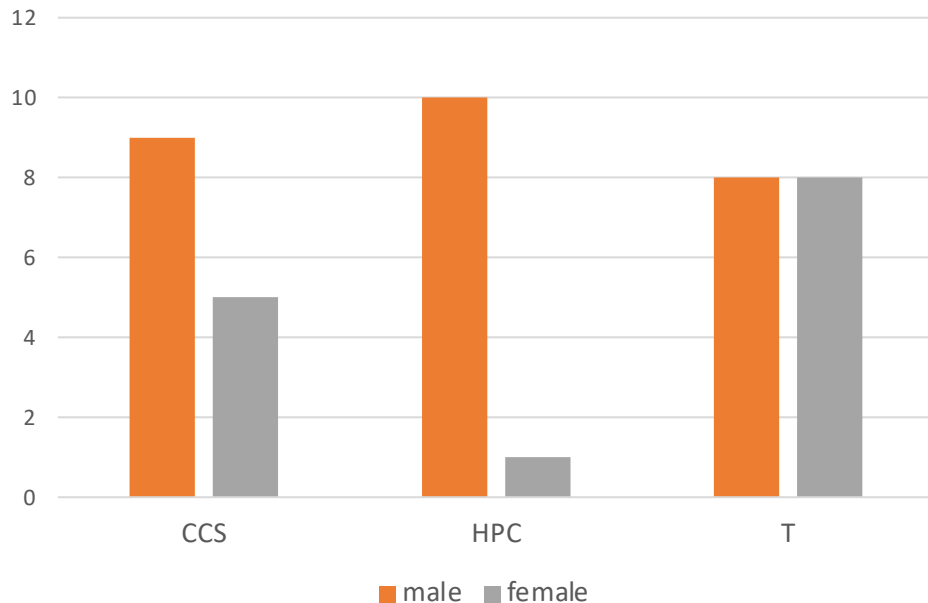


# Selected diversity measures in ALDSC 2020 hires

Types of hires in 2020

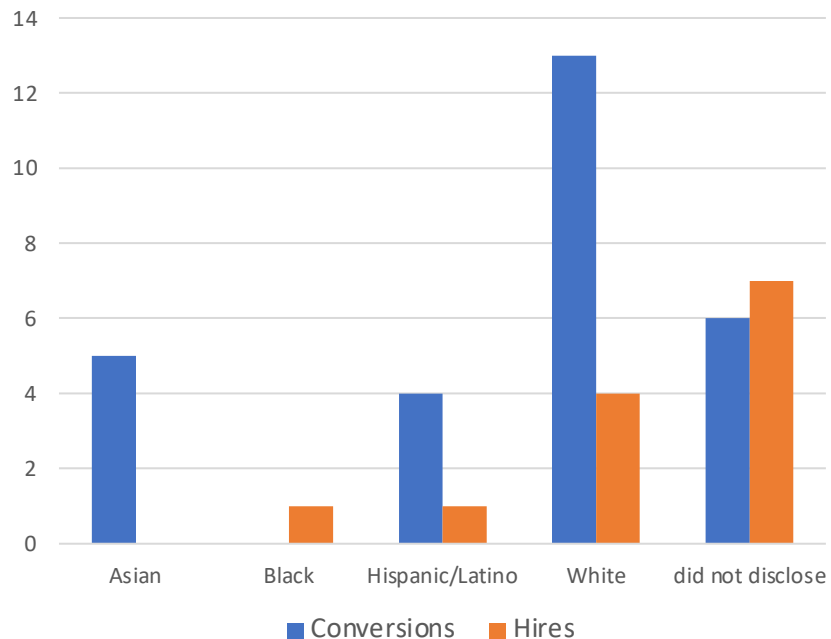


Division Hires by Gender

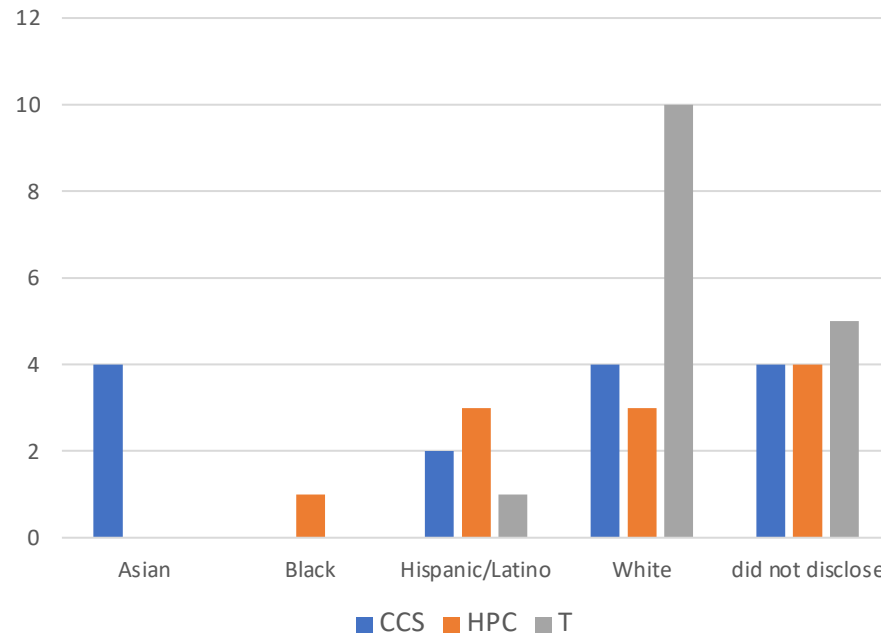


# Selected diversity measures in ALDSC 2020 hires

## Hires by Ethnicity



## Division Hires by Ethnicity



# Comparing Summer 2020 Onboarding with 2019

**Time required to have tools for the job (computers, network access, etc.)**

	2 days	1 week	2 weeks	> 2 weeks
2019	55%	32.7%	9.4%	3.0%
2020	31.5%	32.3%	27.7%	8.5%

**Time required to have conversation regarding expectations with mentor**

	2 days	1 week	2 weeks	> 2 weeks
2019	62.6%	23.4%	7.0%	7.1%
2020	66.2%	22.3%	6.2%	5.4%



# 2021 Student planning

- Hiring process has been streamlined
  - Management approvals are built into the package approval process
  - Includes returning and new students
- ALDSC students remain virtual this summer
- Most students will be hired on as employees, exceptions (with DL, ALD approvals) can be brought in under fellowships.
- Students can work from a foreign country; we cannot ship them a LANL computer.



## Be precise

- In your work plan, describe the work and the methods of communication clearly.
- In the FVTS, if needed, describe clearly the network and computer requirements.



# Welcome new group leaders

## New group leader

- Patrick Jackson – HPC-DCM

## New Acting group leaders

- Joe Err – CCS-2 DGL
- Hashem Mourad – T-3 DGL
- Wes Even – T-5 GL
- Rao Garimella – T-5 DGL
- Ben McMahon – T-6 GL
- Ethan Romero-Severson – T-6 DGL



# Thank you

## Those moving out of GL positions

- Elizabeth Hunke – T-3 DGL
- Pieter Swart – T-5 GL
- Dave Moulton – T-5 DGL
- Nick Hengartner – T-6 GL

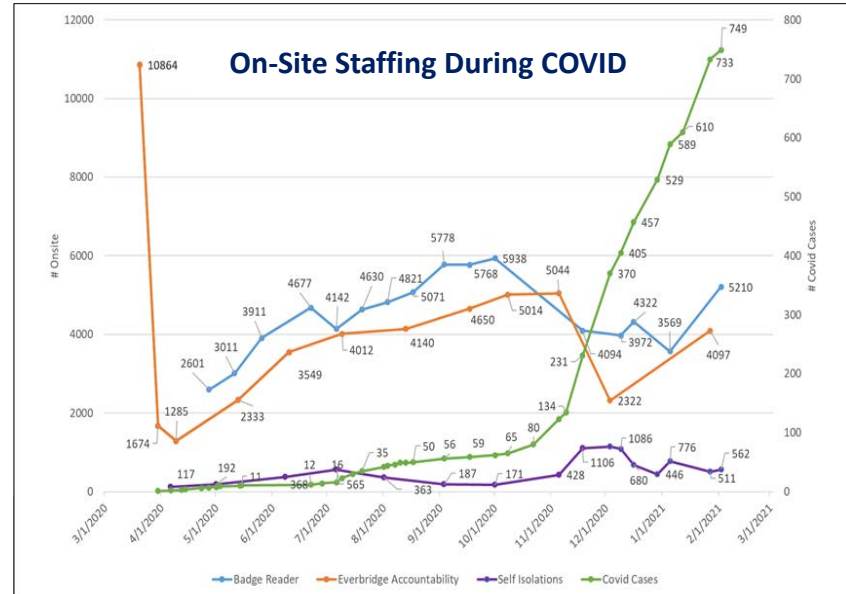
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# Work re-imagined post-COVID

- COVID Status
  - COVID testing continues
  - All restrictions and protocols will remain in place until further notice
- Vaccine Status
  - First DOE/NNSA site to administer vaccines; vaccines will be given in phases per CDC and State guidelines
- Teleworking
  - More than 1,300 staff to be relocated into newly refurbished spaces
  - More than 300 workstations made available to the Weapons Program
  - Collaborative spaces available for all staff



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# Our capability pillars

Six key areas of science,  
technology, and  
engineering  
in which we must lead



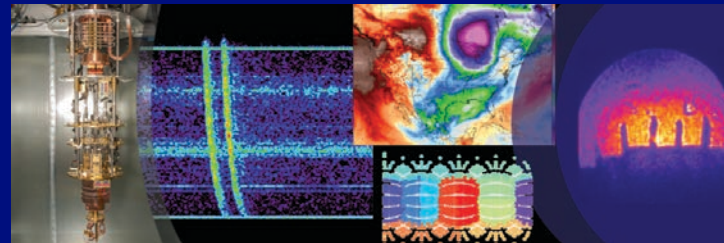
<b>MATERIALS FOR THE FUTURE</b>	Defects and Interfaces Extreme Environments Emergent Phenomena
<b>NUCLEAR AND PARTICLE FUTURES</b>	Applied Nuclear Science & Engineering Nuclear & Particle Physics, Astrophysics & Cosmology Accelerator Science & Technology High Energy Density Physics & Fluid Dynamics
<b>INTEGRATING INFORMATION, SCIENCE, AND TECHNOLOGY FOR PREDICTION</b>	Computing Platforms Computational Methods Data Science
<b>SCIENCE OF SIGNATURES</b>	Nuclear Detonation Nuclear Processing, Movement, Weaponization Natural and Anthropogenic Phenomena
<b>COMPLEX NATURAL AND ENGINEERED SYSTEMS</b>	Human–Natural System Interactions: Nuclear Engineered Systems Human–Natural System Interactions: Non-Nuclear
<b>WEAPONS SYSTEMS</b>	Design Manufacturing Analysis

# Integrating Information, Science and Technology

## Pillar for Prediction

### Three themes

- **Computing Platforms:** Architecture, Technologies, and Infrastructure
- **Computational Science:** Methods, Algorithms, and Implementations to Advance Prediction
- **Data science:** Analytics, Management, Sharing



- Pillar Champion – Irene Qualters
- POC co-lead -Randal Rheinheimer
- POC co-lead Joel Kress

### Four decadal goals

#### Quantum Computing

Realize quantum advantage for mission-relevant challenges in science and security

#### Transform Simulation

Revitalize high fidelity multi-physics, multi-scale simulation for prediction, control, and decision-making

#### Data for Scientific Insight

Advance proficiency in data science for diverse and dynamic data, growing excellence in science and security programs

#### Information Integrity

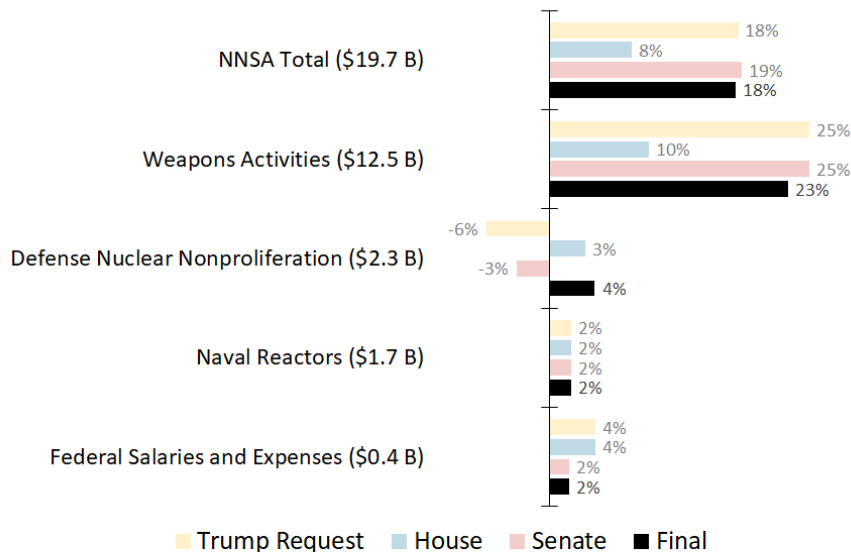
Respond to emerging integrity challenges due to volume, security, and complexity of data, software, and workflow



# FY21 Budget – National Defense Authorization Act approved

## FY21 Appropriations: NNSA

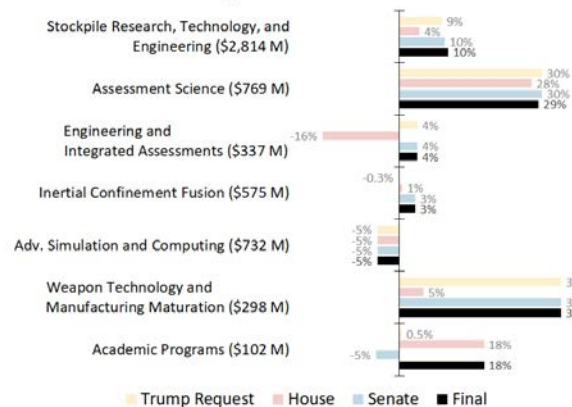
\$ in ( ) are the FY21 amounts



## Weapons research, development, and testing

### FY21 Appropriations: NNSA Stockpile RT&E

\$ in ( ) are the FY21 amounts



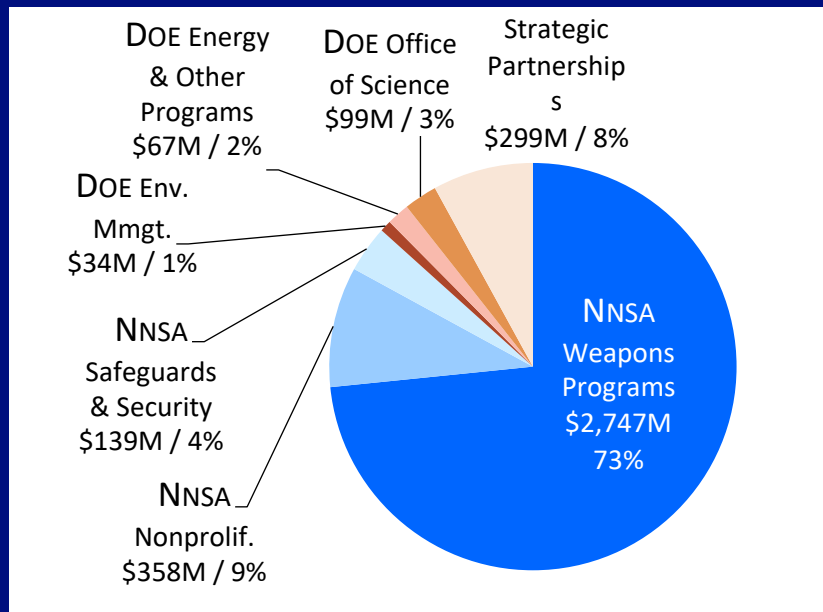
American Institute of Physics | [aip.org/fyi](http://aip.org/fyi)

American Institute of Physics | [aip.org/fyi](http://aip.org/fyi)



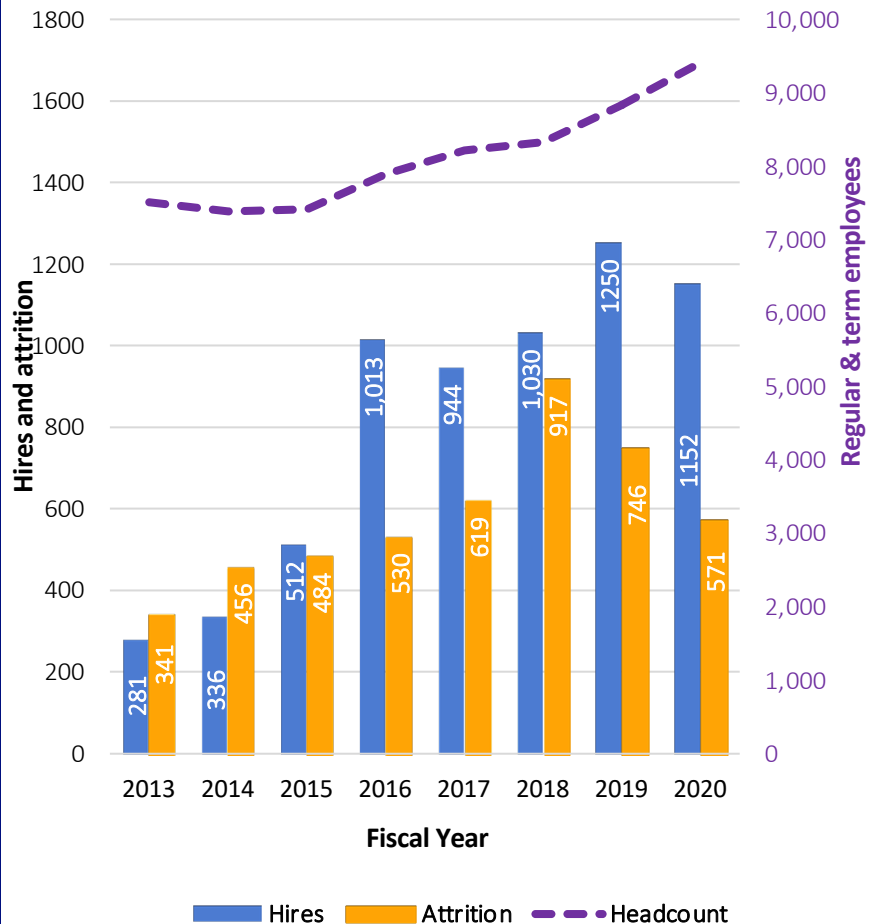
# LANL Budget, employee numbers continue to grow

FY21 LANL Programmatic Portfolio = \$3,743M\*



\* \$550M more than FY20 budget

LANL Hires and Attrition (FY13–20)





# FY21 Lab Agenda

SIMULTANEOUS EXCELLENCE	1.0 NUCLEAR SECURITY	2.0 MISSION-FOCUSED SCIENCE, TECHNOLOGY & ENGINEERING	3.0 MISSION OPERATIONS	4.0 COMMUNITY RELATIONS
<b>Strategic Objective</b> (10–20 years)	<a href="#">Excellence in Nuclear Security</a>	<a href="#">Excellence in Mission-Focused Science, Technology &amp; Engineering</a>	<a href="#">Excellence in Mission Operations</a>	<a href="#">Excellence in Community Relations</a>
<b>Critical Outcomes</b> (5–10 years)	Design, produce, and certify current and future nuclear weapons and reduce global nuclear threats	Deliver scientific discovery and technical breakthroughs that support DOE and NNSA missions	Execute sustained operations that are reliable and responsive to mission needs	Sustain and enhance LANL's partnership with the community across the Northern New Mexico region
<b>Major Strategic Initiatives</b> (1–5 years)	<p><a href="#">1.1</a> Execute LANL's Manufacturing mission to deliver 30 plutonium pits per year</p> <p><a href="#">1.2</a> Transform nuclear weapons warhead design and production</p> <p><a href="#">1.3</a> Anticipate threats to global security; develop and deploy revolutionary tools to detect, deter, and respond</p> <p><a href="#">1.4</a> Support modernization of LANL warhead systems</p> <p><a href="#">1.5</a> Assess the stockpile as it ages and project weapon systems lifetimes</p>	<p><a href="#">2.1</a> Refresh and refine the LANL capability pillar framework</p> <p><a href="#">2.2</a> Advance accelerator science, engineering, and technology to enable future stewardship capabilities</p> <p><a href="#">2.3</a> Advance the frontiers of computing to exascale and beyond</p> <p><a href="#">2.4</a> Assert leadership in the national quantum initiative</p> <p><a href="#">2.5</a> Develop and implement an integrated nuclear energy and nuclear materials initiative</p> <p><a href="#">2.6</a> Implement an integrated initiative for plutonium and actinide missions based on FY20 strategy</p> <p><a href="#">2.7</a> Implement a national security life sciences initiative</p>	<p><a href="#">3.1</a> Change organizational culture with an emphasis on organizational learning</p> <p><a href="#">3.2</a> Improve integrated planning across priority mission activities and infrastructure</p> <p><a href="#">3.3</a> Address critical issues related to NMCA, nuclear safety, criticality safety, waste, and classified enhancements</p> <p><a href="#">3.4</a> Implement systematic process improvement to drive increased rigor and efficiency in work execution</p> <p><a href="#">3.5</a> Enhance quality of work life, workforce planning, and training and development</p>	<p><a href="#">4.1</a> Continue commitment to the community with educational, economic, and philanthropic investments of time and resources</p> <p><a href="#">4.2</a> Strengthen pipelines and partnerships to build workforce of the future</p> <p><a href="#">4.3</a> Enhance small business participation in executing LANL scope across all directorates</p> <p><a href="#">4.4</a> Demonstrate agility and flexibility in our partnerships, effectively balancing benefit and risks</p>

## [2.3] We are reframing our computing strategy post-Exascale

- **We will successfully deploy Crossroads**
- **We will provide an ability to study the most complex physical systems**
  - Platforms and tools tailored to complex workloads
  - Efficient codes on heterogeneous architectures
  - New methods, algorithms and workflows to support understanding, control and decisions
  - Accelerate development of mission-relevant AI-enabled capabilities and partnerships
- **There are significant challenges**
  - Disruptive technology landscape
  - AI brings opportunity and risk

Accelerated Architectures  
Enabled by Industry-Driven Architectural Trends  
Codesigned to Application Demands



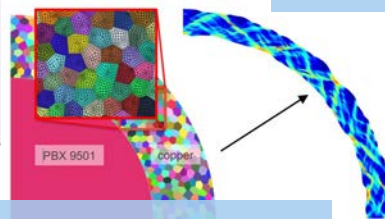
Lawrence Livermore  
National Laboratory

Complex Simulation Architectures  
Leveraging Component-Level  
Customization Tailored for Application

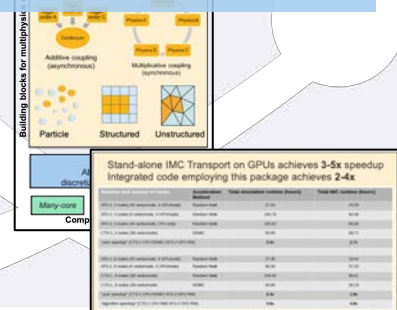


Component-Level Customization

Efficient codes on  
heterogeneous architectures



New computational  
methods and  
workflows



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# We have a new administration in Washington

- Much has changed in D.C. over the last month
  - Jennifer Granholm nominated as Secretary of Energy
  - We have a new acting NNSA Administrator
- The Laboratory's priorities & mission will endure
- We see new opportunities in climate research, nonproliferation, renewable energy, and bioscience



# Our national security mission is broad and important — and motivates and is enabled by ST&E discovery

Ensure the safety, reliability,  
and performance of the  
U.S nuclear stockpile

- Physics & Design
- Engineering
- Production



*Preventing and countering  
efforts of proliferants to  
acquire, develop or  
disseminate materials  
and expertise necessary  
for nuclear weapons*

**NON-PRO  
& COUNTER-  
PROLIFERATION**

**NATIONAL  
SECURITY  
MISSION**

**NUCLEAR  
DERERENCE**

*Excellence in nuclear security  
to ensure the nation's nuclear  
deterrent through theory,  
modeling and simulation,  
and experimentation*

**CROSS  
DOMAIN  
DERERENCE**



**Energy security**

- Sustainable Nuclear Energy
- Resilient Materials
- Complexity in Energy Systems

*Supporting the DoD, IC, and other national security partners to  
execute multidomain operations across land, air, sea, space, and cyber*



# **The right program strategy (and portfolio) balances evolving national policy priorities and enduring technical strengths**

- We seek a portfolio that provides stability for our ST&E capability base as administration agendas shift (and NNSA RDT&E remains constrained)
- We have certain unique skills and it is our responsibility to bring those skills to bear in the interest of national security
- We perceive gaps nationally in the set of skills required for national security; we aspire to fill those gaps that are synergistic with our (evolving) core competencies through program diversification
- We must be scientifically vibrant and relevant. It is core to our culture and is essential for our core nuclear deterrence mission



**Thank you...Questions, Comments**

